SECTION 1: Product and Company Identification

1.1 Product identifier

Product name	:	Carbon dioxide, liquefied.
Trade name	:	Not applicable.

1.2 Other means of identification

Chemical Name	:	Carbon dioxide
Chemical Formula	:	CO_2

1.3 Recommended use and restrictions on use

Product use	:	Semiconductor Processes Industrial & Professional use Synthetic/Analytical chemistry Photovoltaic Processes

1.4 Details of supplier of the safety data sheet

Company identification	:	Iwatani Corporation (Singapore) Pte. Ltd.
Address	:	6 Shenton Way, OUE Downtown 2 #13-11, Singapore 068809
Phone	:	+65 6862 2111

1.5 Emergency contact

Emergency phone number	:	+65 6220 8347

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Physical hazards	:	Gases under pressure- liquefied gas.
Characteristic	:	Non-flammable.
Acute toxicity (inhalation)	:	Not classified.
Skin corrosion/irritation	:	Not classified.
Serious eye damage/eye irritation	:	Not classified.
Acute aquatic toxicity	:	Not classified.

2.2 GHS label elements, including precautionary statements

Pictogram(s) :

Signal word(s)	:	Warning
Hazard statement(s)	:	H280 – Contains gas under pressure; may explode if heated
Precautionary statements		
Prevention	:	None.
Response	:	None.
Storage	:	P403+P410 - Store in a well-ventilated place. Protect from sunlight.

Disposal : None.

2.3 Other hazards which do not result in classification

Other hazards : Asphyxiant in high concentrations. High concentrations may cause asphyxiation, contact with liquid may cause cold bums/frost bite.

SECTION 3. Composition/Information on ingredients

3.1 Substances / 3.2. Mixture

Substance name	Contents	CAS No.
Carbon dioxide	Concentration is nominal. For the exact product composition, please refer to Iwatani technical specifications.	00124-38-9

SECTION 4. First-aid measures

4.1 Description of first aid measures

Inhalation : In high concentrations may cause asphyxiation. Symptoms may include loss of mobility/consciousness. Victim may not be aware of asphyxiation.
Low concentrations of CO2 cause increased respiration and headache.
Remove victim to uncontaminated area.
Wearing self-contained breathing apparatus. Keep victim warm and rested.
Call a doctor. Apply artificial respiration if breathing stopped.

Skin contact : In case of frostbite, obtain medical treatment immediately. Wash frost bitten areas with plenty of water.
Do not remove clothing. Do not rub frozen parts as tissue damage may result.
Cover wound with sterile dressing.
As soon as practical, place the affected area in a warm water bath- which has a temperature not to exceed 40°C (105 °F).

Eye contact : Immediately flush eyes thoroughly with water for at least 15 minutes.
In case of frostbite spray with water for at least 15 minutes.

Ingestion : Ingestion is not considered a potential route of exposure.

SECTION 5. Fire-fighting measures

5.1 Extinguishing media

Suitable extinguishing media : Use any standard agent – choose the one most appropriate for type of surrounding fire (material itself is not flammable).

Unsuitable extinguishing media : None.

5.2 Special hazards arising from the substance or mixture

Specific hazard : Exposure to fire may cause containers to rupture/explode. Non-flammable.

Hazardous combustion products : None.

5.3 Advice for fire-fighters

Special fire fighting procedures : Move container away or cool with water from a protected position. If possible, stop flow of product.

Special protective equipment for fire-fighters : Wear self-contained breathing apparatus for firefighting if necessary.
Firefighters must use standard protective equipment including flame retardant coat, helmet with face shield, gloves, rubber boots, and in enclosed spaces, SCBA.
Guideline:
EN 469 - Protective clothing for firefighters. Performance requirements for protective clothing for firefighting.
EN 15090 - Footwear for firefighters.
EN 659 - Protective gloves for firefighters.
EN 443 - Helmets for fire fighting in buildings and other structures.
EN 137 - Respiratory protective devices - Self-contained open circuit compressed air breathing apparatus with full face mask - Requirements, testing, marking.

SECTION 6. Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Evacuate area. Wear self-contained breathing apparatus when entering area unless atmosphere is proved to be safe.
Ensure adequate air ventilation.

6.2 Environmental precautions

Prevent further leakage or spillage.
Prevent from entering sewers, basements and work pits, or any place where its accumulation can be dangerous.
Do not discharge into any place where its accumulation could be dangerous.

6.3 Methods and materials for containment and cleaning up

Methods for cleaning up : Ventilate area.

SECTION 7. Handling and storage

7.1 Precautions for safe handling

Suck back of water into the container must be prevented. Do not allow back feed into the container.
Use only properly specified equipment which is suitable for this product, its supply pressure and temperature.
Contact your gas supplier if in doubt.
Refer to supplier's container handling instructions.

7.2 Conditions for safe storage, including any incompatibilities

Storage Conditions : Keep container below 50 °C in a well-ventilated place.

SECTION 8. Exposure controls/personal protection

8.1 Control parameters/Occupational exposure limits

Components	CAS-No.	Value type (form of exposure)	Control parameters/permissible concentration	Basis
Carbon dioxide	00124-38-9	TLV	5000 ppm	ACGIH 1994-1995 edition
		MAK	5000 ppm	Germany: TRGS 900 6/1994
		PEL (long term)	5000 ppm: 9000 mg/m^3	Singapore
		PEL (short term)	30,000 ppm: 54,000 mg/m^3	Singapore

TLV= threshold limit value; MAK= Maximum Concentration Value in the Workplace; PEL= Permissible Exposure Limit

8.2 Appropriate engineering control measures

Natural or mechanical to prevent oxygen deficient atmospheres below 19.5% oxygen.
Oxygen detectors should be used when asphyxiating gases may be released.
Keep self-contained breathing apparatus readily available for emergency use.
CO2 detector should be used when CO2 may be released.

8.3 Personal protection

Individual protection measures, such as personal protective equipment (PPE) : A risk assessment should be conducted and documented in each work area to assess the risks related to the use of the product and to select the PPE that matches the relevant risk. The following recommendations should be considered: Protect eyes, face and skin from liquid splashes. PPE compliant to the recommended EN/ISO standards should be selected.

Hand protection : Sturdy work gloves are recommended for handling cylinders. Loose fitting thermal insulated or leather gloves.
Standard EN 388 – Protective gloves against mechanical risk.
Wear cold insulating gloves when transfilling or breaking transfer connections.
Standard EN 511 – Cold insulting gloves.

Eye/face protection : Safety eyewear, goggles or face-shield to EN166 should be used to avoid exposure to liquid splashes. Wear eye protection to EN 166 when using gases. Where there is reasonable probability of liquid contact, wear chemical safety goggles.
EN 166 - Personal Eye Protection.

Skin or Body protection : Never allow any unprotected part of the body to touch uninsulated pipes or vessel which contain cryogenic fluids. The extremely cold metal will cause the flesh to stick and tear when one attempts to withdraw from it. Safety shoes are recommended when handling cylinders.
Wear safety shoes while handling containers.
ISO 20345 - Personal protective equipment - Safety footwear.

Respiratory protection : Use self-contained breathing apparatus (SCBA) or positive pressure airline with mask are to be used in oxygen-deficient atmospheres.

Hygiene measures : Handle in accordance with good industrial hygiene and safety practice.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance

Physical state	:	Gas
Colour	:	Colourless.
Odour	:	No odour warning properties.
Odour threshold	:	Odour threshold is subjective and inadequate to warn of overexposure.
pH	:	No applicable.
Melting point	:	-56.6 °C (-69.88 °F)
Boiling point	:	-78.5 °C (-109.3 °F)
Flash point	:	Not applicable.
Critical Temperature	:	30 °C (86 °F)
Flammability (solid, gas)	:	This product is not flammable.
Lower explosive limit	:	Not applicable.
Upper explosive limit	:	Not applicable.
Vapour pressure @ 20 °C	:	57.3 bar
Relative density, gas (air=1)	:	1.52
Relative density, liquid (water=1)	:	0.82
Molecular mass	:	44 g/mol
Solubility	:	Water 2000 mg/l
Viscosity	:	No data available.
Partition coefficient: n-octanol/water	:	Not applicable.
Evaporation rate	:	Not applicable.
Decomposition temperature	:	Not applicable.
Autoignition temperature	:	Not applicable.
Others	:	Gas/Vapour heavier than air. May accumulate in confined spaces, particularly or below ground level.

Section 10. Stability and reactivity

10.1 Reactivity

No reactivity hazard other than the effects described in sub-section below.

10.2 Chemical stability

Stable under normal conditions.

10.3 Possibility of hazardous reactions

None.

10.4 Conditions to avoid

Due to the presence of Carbon dioxide, Carbonic acid is formed in the presence of moisture.

10.5 Incompatible materials

Certain reactive metals, hydrides, moist cesium monoxide, or lithium acetylene carbide diamino may ignite.
Passing carbon dioxide over a mixture of sodium peroxide and aluminium or magnesium may explode.

10.6 Hazardous decomposition products

Oxygen. Carbon monoxide (CO).

SECTION 11. Toxicology information

Low concentrations cause rapid circulatory insufficiency.
Symptoms are headache, nausea and vomiting, which may lead to unconsciousness.
Unlikely simple asphyxiants, carbon dioxide has the ability to cause death even when normal oxygen levels (20-21%) are maintained. 5% CO_2 has been found to act synergistically to increase the toxicity of certain other gases (CO, NO_2).

11.1 Information on toxicological effects

No known toxicological effects from this product.

SECTION 12. Ecological information

12.1 Ecotoxicity

No ecological damage caused by this product.

12.2 Persistence and degradability

Not established.

12.3 Bioaccumulative potential

Not established.

12.4 Mobility in soil

No additional information available.

12.5 Other adverse effects

When discharged in large quantities may contribute to the greenhouse effect.
Global warning potential [CO_2=1]: 1

SECTION 13. Disposal information

13.1 Disposal methods

Waste disposal recommendations	:	Do not discharge into any place where its accumulation could be dangerous. To atmosphere in a well-ventilated place. Discharge to atmosphere in large quantities should be avoided. Contact supplier if guidance is required. Return unused product in original cylinder to supplier.
Contaminated packaging	:	Return in the shipping container PROPERLY LABELED WITH ANY VALVE OUTLET

PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to Iwatani for proper disposal.

SECTION 14. Transport information

14.1 UN number

: UN1013

14.2 UN proper shipping name

: CARBON DIOXIDE

14.3 Transport Hazard Class(es)

UNRTDG (United Nations Recommendations Transport Dangerous Goods)

Class : 2.2
Subsidiary risk : Not classified.

IATA-DGR (International Air Transport Association – Dangerous Goods)

Class : 2.2
Subsidiary risk : Not classified.

IMDG (International Maritime Dangerous Goods) – Code

Class : 2.2
Subsidiary risk : Not classified.

14.4 Packing group

Not assigned by regulation.

14.5 Environmental hazards

None.

14.6 Special precaution for user

Avoid transport on vehicles where the load space is not separated from the driver's compartment.
Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency.
Before transporting product containers:

- Ensure there is adequate ventilation.
- Ensure that containers are firmly secured.
- Ensure valve is closed and not leaking.
- Ensure valve outlet cap nut or plug (where provided) is correctly fitted.
- Ensure valve protection device (where provided) is correctly fitted.

SECTION 15. Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture:

Restrictions on use	:	None.
Other information, restriction and prohibition regulations	:	Ensure all national/local regulations are observed.
Applicable national regulations	:	Safety, health and environmental regulations/legislation specific for the substance or mixture are observed.

SECTION 16. Other information

16.1 Other information

Indication of changes	:	Ensure all national/local regulations are observed.
Disclaimer of liability	:	Before using this product in any new process or experiment, a thorough material combability and safety study should be carried out. Details given in this document are believed to be correct at the time of going to press. Whilst proper care has been taken in the preparation of this document, no liability for injury or damage resulting from its use ca be accepted.

End of Safety Data Sheet